Original Article

Effectiveness of Crocodile Breathing Versus Prone Position in Patients with COVID-19: A Pilot Study

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Abstract

Introduction: Physiotherapy and medical management have shown to be beneficial in managing COVID-19 patients. Prone positioning was maximally used in managing these patients, which helped improve ventilation. Crocodile breathing emphasizes diaphragmatic recruitment, decreases accessory muscle use, and triggers the body's relaxation response. The study aims to see the immediate effect of crocodile breathing versus prone positioning in COVID-19. **Methods:** Thirty participants who passed the eligibility criteria were randomly assigned into two groups. Group A was asked to perform standard of care treatment followed by prone positioning, and after a washout period of a day, they were made to perform standard of care treatment followed by crocodile breathing. Group B performed crocodile breathing on Day 1 and prone positioning on the next day. Outcome measures pulse rate, respiratory rate, rate of perceived exertion, oxygen saturation, single-breath count (SBC), and chest expansion. The patient's feedback was recorded immediately within 1 min pre and post-treatment on both days. **Results:** Significant improvement was seen in physiological parameters ($P < 0.0001$), chest expansion ($P < 0.0001$), and SBC ($P < 0.0001$) in both groups. However, crocodile breathing was seen to be more effective than prone positioning on SBC ($P < 0.0001$), rate of perceived exertion ($P = 0.000$), and chest expansion ($P < 0.0001$). Twenty-six out of 30 (86%) participants reported crocodile breathing was a more comfortable and better position to relieve dyspnea. **Conclusion:** Crocodile breathing effectively manages COVID-19 and can be safely incorporated into physiotherapy management for patients with COVID-19.

Keywords: COVID-19, crocodile breathing, physiotherapy, prone positioning

Introduction

COVID-19, causigured by SARS-CoV-2, has triggered a global pandemic. The unknown pathogenicity of this disease has led to continuous, rapid research participation and engagement of the scientific community.[1] Initially, the Chinese Centre for Disease Control declared that the majority of the cases were mild (81%), being asymptomatic or majorly with nonpulmonary symptoms. The other 14% progress in developing pneumonia, and 5% develop acute respiratory distress syndrome (ARDS) and need intensive care.[2] Signs and symptoms of COVID-19 are classified as asymptomatic; mild (fever, fatigue, breathlessness, sore throat, runny nose, myalgia, expectoration, loss of smell or taste, and digestive symptoms), moderate (pneumonia without hypoxemia), and severe (pneumonia with hypoxemia, SPO_2 <92% and critical ARDS, shock, encephalopathy, cardiac injury, heart failure, coagulation dysfunction, and renal injury).[3] The pathophysiological mechanisms in mild-to-severe disease progression remain uncertain, requiring further investigation to formulate therapeutic decisions. Physiotherapy treatment has been proven to be an efficient adjunct to medical management in COVID-19 patients. It consists of relaxation, breathing exercises, airway clearance maneuvers, body positioning, mobility, strength, and aerobic training.[4-6] Body positioning directly affects oxygen transport and is a noninvasive physiotherapy intervention that improves

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arterial oxygenation. It helps to postpone, reduce, or avoid invasive, mechanical, and pharmacological forms of respiratory support. Prone position improves ventilation by altering ventilation-perfusion mismatch, reducing physiological shunt, increasing lung volume, and recruitment of dorsal lung regions. It prevents atelectasis and secretion clearance and causes a beneficial fluid shift.[7] Breathlessness is the primary symptom of COVID-19; patients were majorly found to be apical breathers with excessive accessory muscles. Apical breathing causes the structure to tilt back with every breath, limiting mobility in the thoracic spine.

Crocodile breathing involves recruitment of the diaphragm in the prone position, increasing pelvic control, encouraging proper sequencing, and activation of core muscles which causes stabilization of the shoulder girdle, allowing the lower rib cage to expand.[8] It causes diaphragmatic recruitment, which triggers the body's relaxation response, improves oxygen saturation and resolution of atelectasis, and lowers anxiety and eupnea. Yong Ho Cho *et al*. (2019) observed that crocodile breathing was beneficial in managing musculoskeletal conditions such as lower back pain and scapular dyskinesia. However, there is a lack of literature on the benefits of crocodile breathing in respiratory diseases.[9] Hence, the study aimed to compare the effects of crocodile breathing and prone positioning on physiological parameters in COVID-19 patients.

Subjects and Methods

A Quasi-controlled crossover experimental pilot study was conducted at a dedicated COVID tertiary care hospital in Mumbai after seeking approval from the institutional ethics committee and registration in Clinical Trial Registry – India (CTRI-REF/2021/01/040164). A total of 30 inpatients met the eligibility criteria, as shown in Figure 1. Pregnant, obese, and those on rebreathing masks and invasive and noninvasive ventilator support were excluded as prone to lying are uncomfortable due to abdominal bulk and oxygenation tubes, respectively.[10-12] After explaining the study procedure in detail, written informed consent was taken from the patients. Demographic data were collected, including anthropometric measures, vital parameters, and comorbidities. Patients were randomly assigned into two groups using a chit method. Group A was administered with 15 min of prone positioning on Day 1 and 30 counts of crocodile breathing on Day 2, along with the standard of care treatment. It is inconvenient to perform more than 30 counts of diaphragmatic breathing in prone as it causes fatigue. Hence, the duration of the maneuver was set considering the comfort of the patient and therapeutic effects. Group B was administered with 30 counts of crocodile breathing on Day 1 and 15 min of prone positioning on Day 2, along with the standard of care treatment. Pre- and Posttreatment physiological parameters (pulse rate, respiratory rate, rate of perceived exertion, and oxygen saturation), single breath count (SBC) using a metronome, and chest expansion was measured immediately within 1 min [Figure 2]. An open-ended question regarding the choice of positioning was recorded on the 2nd day in the language preferred by the patient and later transcribed.

Crocodile breathing patient lies comfortably on abdomen with head in midline resting on both hands. Patients take slow nasal inhalation for 3 s, followed by a brief pause. Slow nasal exhalation for 4–6 s, followed by a longer pause. During the next breath cycle, the chest should expand, filling the "cylinder" of the abdomen. The anterior chest wall and abdomen are stabilized, and upper limbs are stabilized in abduction. During this therapist uses his hand to guide the patient in the lumber movement [Figure 3]. Thus, greater pressure is placed on the posterior and lateral chest wall and pelvis during inspiration, reducing accessory muscle use.[13]

Outcome measures

Primary

1. Pulse rate, respiratory rate, rate of perceived exertion, and oxygen saturation
2. SBC: This measurement is based on how far an individual

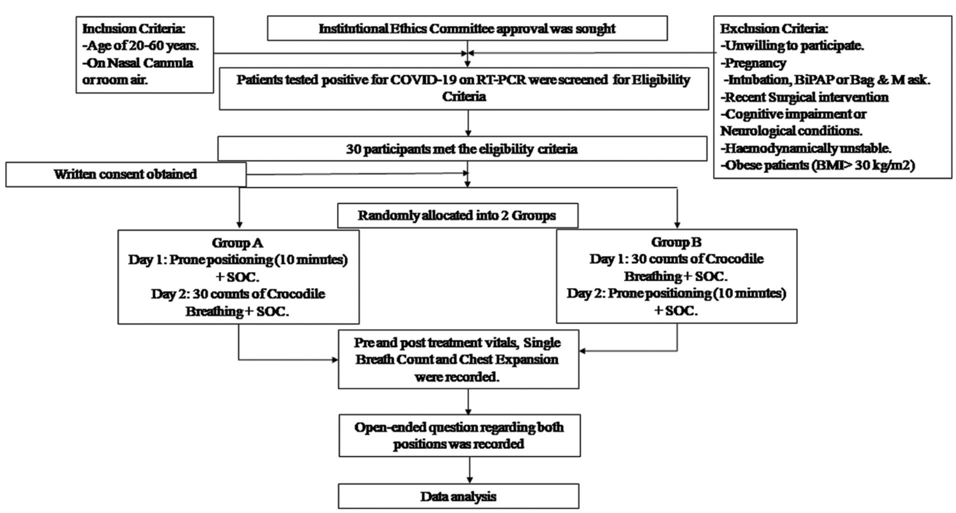

Figure 1: Methodology

can count with a normal speaking voice after one maximal inhalation effort. The count is synced with a metronome at 2 bps[14]

3. Chest expansion: Using a measuring tape, chest expansion is measured at nipple level during the end of deep inspiration and expiration. Normally, a 2–5" of chest expansion can be observed.[15]

Secondary

1. Patient's feedback: On Day 2, the patient's feedback about the comfort and preference for both positions were recorded and later transcribed.

Data analysis

Data analysis was done using SPSS Version 16 (IBM, Chicago, Illinois, USA). Physiological parameters (pulse rate, respiratory rate, rate of perceived exertion and oxygen saturation, SBC, and chest expansion) were tested for normality. Paired *t*-test and Wilcoxon ranks test were used depending upon the normality. For the open-ended question, qualitative content analysis was used.

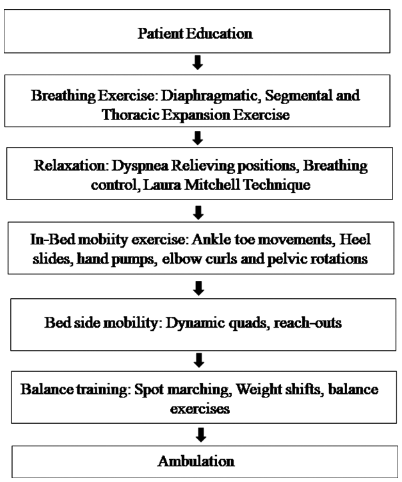

Figure 2: Physiotherapy management

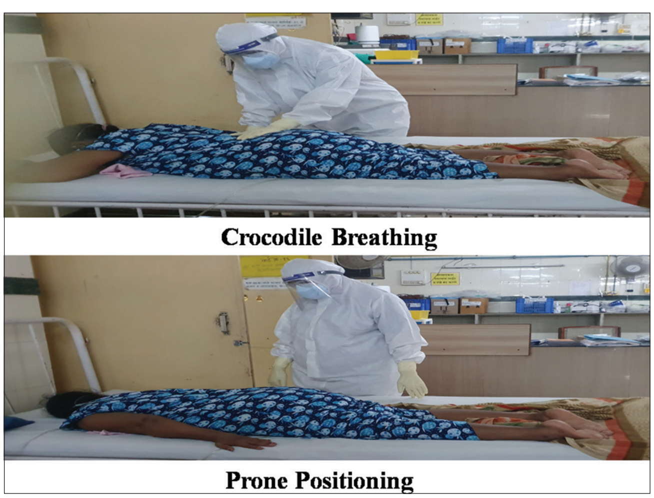

Figure 3: Crocodile breathing and prone positioning, Prone positioned the patient lying on the abdomen with his head turned to one side. Legs are relaxed, toes face outward, and arms are placed on the sides

Results

Thirty inpatients within 20–60 years with a mean age of 49.10 ± 7.798 years were included in the study, out of which 21 (70%) were male, and 9 (30%) were female. Based on the severity of COVID-19, 8 (26.6%) patients had mild affection, 150 (50%) had moderate affection, and 7 (23.33%) had severe affection. Patients in the study reported comorbidities in the form of diabetes mellitus 5 (16.66%), hypertension 5 (16.66%), 8 (26.66%) participants reported both diabetes and hypertension, and 12 (40%) reported no comorbidities. Out of 30 patients' modes of oxygen 2 (6.6%) patients were on 2 L of nasal O2, 1 (3.3%) was on 3 L of nasal O2, and 27 (90%) were on room air. Significant improvement was seen in physiological parameters ($P < 0.0001$), chest expansion ($P < 0.0001$), and SBC ($P < 0.0001$) in both groups [Table 1]. Crocodile breathing was found to be more effective than prone positioning on SBC ($P < 0.0001$), rate of perceived exertion ($P = 0.000$), and chest expansion ($P < 0.0001$) [Figure 4]. Patient rated question reported that 26 (86%) participants found crocodile breathing to be a more comfortable position in relieving dyspnea, while 4 (14%) participants preferred prone positioning due to the discomfort and difficulty in performing deep breathing associated with crocodile breathing.

Discussion

Physiotherapy management in adjunct to medical management has shown to improve functional capacity with a favorable effect on oxygen saturation in COVID-19. The increase in saturation occurs due to an increase in breathing capacity. This aids in early weaning from external oxygen dependency and reducing hospital stay. It improves patients' respiratory function, exercise endurance, and physical strength, which inhibits the occurrence of various complications or disuse syndromes. Preventing patients from various physical and psychological disorders can facilitate patients' return to family, work, and society as soon as possible and improve their quality of life.[4-6]

In many studies, prone positioning, an integral part of CARP protocol, has been shown to positively affect patients with COVID-19. Prone positioning is feasible and may yield improvements in many patients with COVID-19 who are receiving respiratory support. It had also shown great improvement in increasing lung recruitment and improving oxygenation. Prone positioning is one of the most used physiotherapy maneuvers. According to the literature, prone positioning improved respiratory mechanics, pleural pressure gradient, alveolar inflation, and ventilator distribution. This helps to increase lung volume and reduce atelectasis.[16]

Physiotherapists have used diaphragmatic respiration to manage various respiratory conditions. It has been shown to improve respiration, chest expansion, and stress reduction.

Crocodile breathing mainly involves breathing by diaphragmatic activation. When one uses their diaphragm to breathe instead of the more typical "shallow breathing" of the intercostals

Table 1: Statistical analysis

Variables	Prone positioning		Crocodile breathing		Difference within	
	Pre	Post	Pre	Post	PP	CB
Chest expansion						
Mean±SD	2.65333±0.95664	3.08667±0.87282	2.78333±0.84659	3.58±0.75383	0.433333±0.280872	0.796667±0.50891
P	0.000		0.000		0.000	
Statistical test	Paired *t*-test		Wilcoxon test		Mann–Whitney test	
Pulse rate						
Mean±SD	90.86±14.51	87.533±14.82	88.166±1.267	83.566±1.3161	−3.333±4.685	−4.600±2.931
P	0.000		0.000		0.273	
Statistical test	Wilcoxon test		Wilcoxon test		Mann–Whitney test	
Respiratory rate						
Mean±SD	21.733±3.268	19.400±2.415	21.26±2.651	19.600±2.061	−2.333±1.7485	−1.666±1.4932
P	0.000		0.000		0.093	
Statistical test	Wilcoxon test		Wilcoxon test		Mann–Whitney test	
SpO_2						
Mean±SD	96.366±17.865	95.233±16.329	96.533±1.547	98.966±0.764	−1.1333±16.296	2.4333±1.452
P	0.000		0.000		0.064	
Statistical test	Wilcoxon test		Wilcoxon test		Mann–Whitney test	
Single breath count						
Mean±SD	18.966±5.492	23.00±6.9331	20.066±5.445	27.800±7.25442	4.033±7.733	7.733333±3.2476
P	0.000		0.000		0.000	
Statistical test	Wilcoxon test		Paired *t*-test		Mann–Whitney test	
RPE						
Mean±SD	0.0833±0.1895	0±0	0.1500±0.2330	0.0333±0.12685	−0.0833±0.1895	0.116±0.21509
P	0.000		0.000		0.000	
Statistical test	Paired *t*-test		Paired *t*-test		Independent *t*-test	

SD: Standard deviation, SpO_2: Oxygen saturation, RPE: Rating of perceived exertion, The above table shows *P* values for each outcome measure which was derived by using paired *t*-test for data passing normality and Wilcoxon test for data not passing normality of dependent variable. Similarly, for the independent variable, independent t-test was done for data passing normality and the Mann–Whitney test for data not passing normality.

Figure 4: Comparison of crocodile breathing and prone position on physiology parameters and single-breath count

muscles, greater thoracic mobility is established, and enhanced core muscle activation is enabled. This improves the mobility of the shoulder girdle, increases pelvic control, and encourages proper sequencing in the firing of core muscles for greater trunk stabilization.[9,13] Crocodile breathing involves taking diaphragmatic breaths while lying face-down, also known as Makarasana in Yoga. Crocodile breathing has been shown to positively affect patients experiencing low back pain and improve shoulder girdle mobility.[8,9] There is a lack of evidence on whether crocodile breathing improves the functional level of the respiratory system among patients diagnosed with COVID-19.

In the present study, patients were given prone positioning along with the standard of care treatment on Day 1, and on Day 2, they were administered 30 counts of crocodile breathing along with the standard of care treatment. A washout period of 24 h was kept between two interventions to observe their accurate effects. All the patients included in this study were benefited from both interventions (P = 0.001.) On comparing the effect of crocodile breathing and prone positioning on physiological parameters, and the pulmonary function test, it was observed that chest expansion, rate of perceived exertion, and SBC showed significant improvement after receiving crocodile breathing as compared to prone positioning (P = 0.001). Crocodile breathing mainly emphasizes diaphragmatic breathing, which improves the efficiency of ventilation, decreases the work of breathing, and increases the excursion of the diaphragm, leading to an increase in chest expansion. It is also seen diaphragmatic excursion led to better gas exchange and oxygenation, which could be one of the factors that SBC showed significant improvement following crocodile breathing.[17] While respiratory rate, pulse rate, and SPO_2 showed similar improvements after receiving both crocodile breathing and prone positioning (P > 0.001).

An open-ended, semi-structured subjective question regarding the choice of position between crocodile breathing and prone positioning was asked to the patients after both physiotherapy interventions on Day 1 and Day 2. The answers were recorded and transcripted according to the patient's description of the better position. The majority of patients used words such as "comfortable, better, good, easy, and tolerable" to describe crocodile breathing. Twenty-six participants found crocodile breathing was a more comfortable and better position to relieve dyspnea. The remaining four participants used the "discomfort" word to describe crocodile breathing; therefore, they found prone lying positioning better than crocodile breathing due to difficulty in performing deep breathing. The study has some limitations as it was a pilot study the sample size was less. The rate of perceived exertion, a subjective outcome measure used to assess the perception of breathlessness, differs from patient to patient and hence becomes one of the limitations.

Conclusion

As COVID-19 is still wreaking havoc on the community, the results of this study can be implemented to treat COVID-19 patients along with physiotherapy intervention and medical management. Thus, crocodile breathing can enhance the standard rehabilitation for the COVID-19 study.

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Conflicts of interest

There are no conflicts of interest.

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